Distr.
LIMITED

UNIDO/IO.587
20 July 1984

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

English

UNIDO's

PRE-INVESTMENT STUDIES PROGRAMME

Feasibility Studies*

Prepared by the
Feasibility Studies Section
Division of Industrial Operations

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V.84-88643

UNIDO ACTIVITIES IN PRE-INVESTMENT STUDIES

I. INTRODUCTION

Investment, being the central ingredient of industrialization, is the dominant factor in the attainment of the Lima target. There are many factors influencing industrial investment among which domestic capacity to handle pre-investment and investment activities may be considered crucial. In many developing countries the established institutions entrusted with the responsibility to map out industrial strategy, to prepare pre-investment studies and to implement industrial projects, do lack the required and the experienced cadres to undertake these tasks. Accordingly, UNIDO has oriented its technical assistance programme to respond effectively to the needs of developing countries in these fields.

In his address to the Seventh Conference of Non-Aligned Countries held in New Delhi from 7 to 11 March 1983, the Executive Director stated: "Our main line of business is to render technical assistance bearing upon the software of industrialization, covering pre-investment activities, project preparation and evaluation, technology choices, design engineering and the macro-economic exercise of industrial planning".

II. THE PRE-INVESTMENT STUDIES PROGRAMME

This programme at UNIDO aims at achieving the important objective of building and strengthening national capacities either individually or collectively within the framework of self-reliance. This involves

a) raising the level of local skills by introducing and demonstrating the methodology and requirements for preparing feasibility studies in a comprehensive and balanced manner;
b) establishing the required institutional infrastructure both at national and regional levels which will identify, formulate, evaluate and select industrial projects in terms of their technical and financial feasibility as well as economic and social benefits and costs;
c) assisting developing countries in making the proper decision for the implementation of a specific industrial investment by undertaking or supervising the preparation of the pre-investment study.

Within the present structure of UNIDO the Pre-Investment Studies Programme falls under the jurisdiction of the Division of Industrial Operations and its substantive units. To provide optimum and effective service to governments in this vital field, co-ordination of assistance within UNIDO was entrusted to the Feasibility Studies Section. It is clear that co-ordination would lead to better utilization of resources and would improve the quality and the responsiveness of the pre-investment studies programme. This measure was also intended to enhance the linkage between pre-investment activities and investment. In addition to its co-ordination role, the Section responds to government requests in a variety of modes as explained below.

1. Assistance in Project Identification, Preparation and Evaluation

Pre-investment studies have to be well prepared in order to:

a) avoid wasting domestic resources,

b) enable governments to reach rational decisions, and

c) attract external and internal financing.

Project preparation and evaluation is based on the Manual for the Preparation of Industrial Feasibility Studies which was published by UNIDO in 1978 and which has received wide acceptance. The Manual offers a single format and set of procedures which could be applied to a wide spectrum of industrial projects.

As project planning is an interdisciplinary task requiring a team of engineers, economists, social scientists, businessmen and governmental administrators, the Manual is aimed at readers with different educational backgrounds and professional experiences from both developing and developed countries. The Manual is practical in approach; it aims to put the various feasibility studies into a similar framework with a view to making them easily comparable. Industrial development centres, industrial development banks and public and private consulting firms in developing countries should benefit especially from the Manual. The numerous individual experts assigned to project planning authorities in developing countries should also be able to take advantage of it.

The Manual is available in English, French, Spanish, Russian, Chinese, Turkish, German, Dahri, Hungarian and Czech, and is being translated into Arabic, Polish and Burmese. Some 65,000 copies have been printed in all these languages, and most of these copies have been distributed.

UNIDO has a long experience in the preparation and evaluation of pre-investment studies and will continue to respond to government requests for such assistance. The studies supervised by UNIDO are prepared with impartiality, confidentiality and highest standards and at reasonable cost. Moreover, UNIDO tries to involve local staff in the preparation in order to acquaint them with the methodology and concepts. Also an effort is usually made to recruit experts or consulting firms from developing countries to undertake the assignment where appropriate. Finally, in the case of viable projects UNIDO is also assisting in locating financing institutions and partners, and in all aspects of negotiations and contractual arrangements.

2. Assistance in the Application of the Computer Model for Feasibility Analysis and Reporting (COMFAR)

In view of the wide application of the Manual for the Preparation of Industrial Feasibility Studies, UNIDO has developed a Computer Model for Feasibility Analysis and Reporting (COMFAR). The purpose of the COMFAR software is to enable experts, consultants, consulting firms and UNIDO staff as well as international and national institutions active in the preparation, evaluation and financing of industrial investment projects to facilitate and accelerate the computations required for the preparation and evaluation of financial statements, financial ratios, and rates of return for pre-feasibility and feasibility studies. COMFAR is also a further step towards standardization of pre-investment studies, as strongly recommended by UNIDO's First Consultation on Industrial Financing, held in Madrid in October 1982.

The comparative advantages of COMFAR, implemented on a personal computer, are inter alia: easy access to the computer, a sophisticated but still very flexible financial model, the dialogue system that guides the user through all

operations and includes an input error check and warning system. Computer power allows repeated computations to analyse sensitivity risks involved and to approach optimal project alternatives. The report generation system prints the result tables ready for presentation in project reports.

In order to assist countries to obtain and apply the COMFAR software, UNIDO developed a training programme. For the success of the training programme, it is indispensable that nationals should have the requisite background including thorough knowledge of the UNIDO Manual for the Preparation of Industrial Feasibility Studies. The hardware consisting of a personal computer and related accessories may be obtained through UNIDO or directly by the client.

A brochure giving full details of this Computer Programme had been published recently by the Feasibility Studies Section.

3. Assistance to Strengthen National Capacities in Pre-investment Studies and Investment Follow-up

The setting up of Industrial Advisory Units attached to the appropriate substantive ministry, agency or industrial development bank is an indispensable condition to expand national capacities and strengthen capabilities for the identification, preparation, evaluation and selection of optimum investment projects. The setting up of a national industrial advisory service is a desirable step to be taken by each developing country even though it will take some time to build its capacity fully. It consists of a nucleus of local specialists which may be complemented by drawing on international experts.

UNIDO has been assisting developing countries in setting up an advisory service or a projects planning unit which is tailored to the country's particular needs. Such assistance takes the form of a team of experts composed of an industrial economist (team leader), market and financial analysts, a mechanical engineer and other engineers whose specializations will be determined by the industrial branch to be covered. It is obvious that this type of assistance will enable countries to undertake pre-investment studies themselves and will provide on-the-job training and will lay the foundation for a permanent institutional mechanism.

There is a case for this kind of service to be set up on a regional basis as well to serve a number of neighbouring countries. The regional facility could undertake consultancy and advisory services at the request of member countries for a fee and in some cases free of charge, depending on the financial ability of the beneficiary country. It could also undertake training activities and encourage the formation and strengthening of counterpart local units in the member countries with which it would maintain a working relationship aimed at decentralising certain functions and activities. An additional merit of a regional organization is that it could serve to promote regional industrial planning and co-operation.

A brochure is available outlining details of the type of assistance to be provided by UNIDO to set up Industrial Advisory Units.

4. Assistance to Upgrade National Capabilities in Pre-investment Studies and Investment Follow-up

The shortage of trained manpower in many developing countries has been a major handicap in the preparation of pre-investment studies. This poses a serious constraint to the process of industrialization and consequently to the attainment of the Lima target. It has been clearly recognized that the ability of a country to raise its rate of industrial investment depends on its capacity to design and promote viable projects. In the long run, training policies should aim at achieving self-sufficiency in meeting training requirements preferably at the national level. For the short run, co-operation among developing countries as well as international co-operation in this domain is a necessary option.

In response to the acute needs of developing countries for up-grading of skills in the preparation of pre-investment studies, UNIDO has been organizing programmes at the national, regional and interregional levels during the past 15 years. These programmes are designed to provide economists and engineers in a relatively short time (from 2 to 8 weeks) with the necessary knowledge, both theoretical and practical, in advanced methods and techniques of project preparation, evaluation, financing and promotion.

The seminar is conducted by a team of consultants and the Manual for the Preparation of Industrial Feasibility Studies is among the basic teaching materials used together with the computer supplement COMFAR.

On-the-job training is an integral part of the assistance provided to national institutions engaged in pre-investment studies under the Advisory Unit programme mentioned above. For countries whose capacity for handling pre-investment studies is still inadequate, the services of experts over an extended period are indispensable for buidling such capability and filling immediate needs.

A brochure is available outlining the seminar programme and giving details about the lectures, duration and contents.

5. Assistance to Least Developed Countries Provided by the Interregional Adviser in Pre-investment Studies

The services of the Interregional Adviser in Pre-investment Studies is made available to Least Developed Countries because of their dire need for such assistance. In brief, the Adviser will advise and assist the least developed countries through short-term missions as follows: in the identification, selection and development of potential investment projects with a view to bringing them to a bankable stage; in the setting up and in strengthening national industrial advisory units; in the seminar programme; and in investment follow-up.

Co-operation and co-ordination between the Interregional Adviser and the staff at UNIDO headquarters are to be maintained in order to give support to his activities and to enhance follow-up where necessary.

III. OTHER SERVICES PROVIDED

1. Investment Follow-up

In April 1981 UNIDO signed the Co-operative Arrangement on Investment Follow-up with the United Nations Development Programme under which provision will be made to update existing studies and to provide funding for investment

follow up. The Feasibility Studies Section was assigned as focal point for this co-operative arrangement.

2. Assistance with Negotiations

Upon completion of a feasibility study, a decision to proceed with the project entails negotiations concerning finance, technology and management, contracts, marketing arrangements, tendering procedures and engineering supervision. In collaboration with other sections in UNIDO, the Feasibility Studies Section can provide technical assistance in all aspects of negotiations and contractual project work.

3. Industrial Project Preparation Facility

This new programme is intended to facilitate the preparation of industrial projects by setting up multidisciplinary teams to visit the least developed countries, in particular, and help them prepare and evaluate feasibility studies. The provision of special purpose financing to the United Nations Industrial Development Fund in order to finance pre-investment studies in least developed countries is currently being negotiated.

4. Establishment of an Industrial Project Evaluation Service at UNIDO

The Computer Model for Feasibility Analysis and Reporting (COMFAR) enables UNIDO to extend its Project Evaluation Service in developing countries. Such a service could be used to obtain a neutral assessment of previous project studies prepared by consultants or suppliers of equipment.

5. Work of Methodology

Since its inception UNIDO has undertaken or sponsored work to develop an appropriate and practical methodology for the preparation and evaluation of industrial projects. The results of this supporting activity have been made available to member countries through publications and workshops as well as by experts or consultants who provide technical assistance. The main reference publications which are available in several languages, are:

* Manual for the Preparation of Industrial Feasibility Studies: covers project preparation and financial evaluation (ID/206), available in Chinese, Czech, Dahri, English, French, German, Hungarian, Russian, Spanish and Turkish. Burmese, Polish and Arabic under preparation.

* Guidelines for Project Evaluation (ID/SER.H/2) and Guide to Practical Project Appraisal (ID/SER.H/3) deal with socio-economic evaluation, available in English, French and Spanish.

* Manual for Evaluation of Industrial Projects (ID/244): presents a methodology based on national value-added concepts and is applicable to all developing countries. Available in English, French and Spanish.

IV. HOW TO APPLY

Government authorities should direct all requests for UNIDO assistance to the Resident Representative of the United Nations Development Programme (UNDP). UNIDO is represented in a number of countries by a Senior Industrial Development Field Adviser (SIDFA). The staff of the UNDP Resident Representative's Office and the SIDFA will be in a position to explain in detail the procedures to be followed.

The UNDP Office usually has to agree to the source of finance before requests are made. In addition to UNDP financing, UNIDO has its own source of funds which can be made available for activities such as training workshops, short-term consultants and fellowships/study tours.

In all cases it is advisable to initiate a request well in advance. Further information can be obtain from:

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Distr.
LIMITED

UNIDO/IO.588
23 July 1984

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

ENGLISH

BRIEF PRESENTATION OF THE UNIDO-CZECHOSLOVAKIA JOINT PROGRAMME FOR INTERNATIONAL CO-OPERATION IN THE FIELD OF CERAMICS, BUILDING MATERIALS AND NON-METALLIC MINTERALS BASED INDUSTRIES*

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I. INTRODUCTION

During its six years of existence, the UNIDO-Czechoslovakia Joint Programme has gained a good reputation within developing countries due to its rapidly increasing activities in the field of ceramics, building materials and non-metallic minerals based industries.

UNIDO is faced with the challenge to assist developing countries to attain their industrial objective agreed on at the Second General Conference held at Lima in 1975 to raise their share in global industrial output to at least 25 per cent by the year 2000. A great significance is attached to the development of the building materials and construction industries sector within the overall UNIDO programme because of its importance to the industrial and infrastructural development.

The activities of the Joint Programme, which has assisted developing countries in the wide field embracing ceramics, building materials, glass and application of non-metallic minerals in industries, agriculture and environmental protection focus particularly on the industrial exploitation of local raw materials. Backed by a strong network of industries and research facilities, the Joint Programme has developed a prompt system of testing and evaluating raw materials, developing processing technologies, training technicians, assisting industries and providing technical information.

II. BACKGROUND AND OBJECTIVES

On 20 September 1978, a Memorandum of Understanding was signed between the United Nations Industrial Development Organization and the Government of the Czechoslovak Socialist Republic establishing the UNIDO-CSSR Joint Programme for International Co-operation in the Field of Ceramics, Building Materials and Non-metallic Minerals based Industries. The Joint Programme with its office based in Pilsen commenced its activities on 1 October 1978.

The establishment and orientation of the Joint Programme are in conformity with the conclusions of the Second General Conference of UNIDO, held in Lima in March 1975, and the Third General Conference of UNIDO which took place in New Delhi in January 1980.

The UNIDO-CSSR Joint Programme was established at the Research Institute for Ceramics, Refractories and Raw Materials and it has been backed by the companies associated under the Czechoslovak Ceramic Works, producing a very wide range of non-metallic minerals and ceramic articles totalling about 14,000 different products. It has also been maintaining close contacts with glass, cement, lime, building materials and non-metallic minerals based industries. It has taken advantage of the great Czechokosvak tradition, extensive experience and developed educational system related to the non-metallic industries.

In keeping with the Memorandum of Understanding, the Joint Programme has provided assistance to developing countries in fostering of twinning arrangements between the appropriate Czechoslovak organizations and similar ones in the developing countries, in carrying out individual training of technicains and engineers as well as group training programmes and workshops, in the testing of raw materials together with the related technological research and pilot investigations leading to the selection of appropriate industrial technology, Its staff has carried out exploratory and advisory missions in the relevant technical fields covering such topical issues as energy conservation and is now also concerned with the utilization of non-metallic minerals for soil conditioning and for environmental protection. Special attention is being paid to the Industrial Development Decade for Africa in which the Joint Programme is expected to play a significant role.

III. SIX YEARS OF ACTIVITY

Since 1978 the Joint Programme has been engaged in a wide range of activities of which some examples are quoted in the following paragraphs. As a result, the knowledge about the services available through the Joint Programme is rapidly spreading and the number of high-level officials visiting the Joint Programme office in Pilsen to obtain a first hand-impression of the potential for co-operation is increasing year by year.

Training

The training programme has focused on technological questions related to the various phases of the non-metallic materials flow from the extraction over beneficiation and manufacture to the final application of the products and special attention has been paid to the conservation and management of energy in the silicate industries. All trainees, individual fellows as well as participants in technical workshops, were introduced to the latest technical developments in Czechoslovakia and given the possibility to discuss and seek solutions to their individual technological problems.

The Technical Workshop on the Exploitation and Beneficiation of Non-metallic Minerals, the Technical Workshop on Energy Conservation in Silicate Industries for the Least Developed Countries, and the In-plant Technical Workshop on Energy Conservation and Management in Ceramic Industries organized by the Joint Programme dealt with a broad variety of issues related to the non-metallic raw materials based industries. They were attended by participants representing a total of 23 developing countries.

In addition to the group training participants a total of twenty specialists from different countries followed individually tailored training programmes arranged by the Joint Programme covering such subjects as special laboratory control methods, industrial and agricultural uses of non-metallics, ceramic and refractory production technologies and energy conservation in ceramics.

Exploitation of Local Raw Materials

Effective exploitation of local raw materials requires detailed knowledge about their qualities and possible applications. The products based on non-metallic minerals are today applied in a multitude of heavy and light industries including first and foremost the construction industry and are thus indispensable to the balanced development of any national economy.

In total, 45 reports on raw material tests carried out by the Joint Programme and providing an evaluation of their industrial potential were elaborated for 22 countries. In most cases, the preliminary, laboratory and pilot tests involved technlogical research leading to proposals of processing technologies. The following table illustrates the broad range of technologies covered:

Sector	Raw Material Tested
Ceramics	Clays, kaolins, feldspars, limestones, graphite
Structural ceramics	Brick clays, stoneware clays, kaolins, slags
Glass	Glass sands
Paper and rubber	kaolin (coating and filling kaolins)
Agriculture	Diatomaceous earth, bentonite, perlite
Foundries	Bentonites
Refractories and insulating materials	Kyanites, silica, clays, kaolins, graphite, vermiculite, diatomaceous earth
Cement and lime	Pozzolanas, limestone, gypsum
Sintering materials	Diatomaceous earth, perlite
Protection of environment	Perlite, bentonite

The system of raw materials testing has demonstrated its usefulness as a catalyst for further co-operation. In the case of Suriname, for instance, work started by orientation tests of raw materials and went on to pilot verification tests and elaboration of ceramic technologies including a pre-feasibility study for a wall and floor tile manufacture. Further technical assistance to the ceramic industries in Suriname was provided, technicians were trained in the Joint Programme and project proposals for a twinning arrangement and long-term technical assistance elaborated.

Transfer of Technical Knowledge

The Joint Programme, taking advantage of the wide know-how of Czechoslovak ceramic industries, has extended direct assistance to the developing countries in all phases of industrial exploitation of non-metallic raw materials. Participating in UNIDO operational projects, the experts of the Joint Programme have visited Brazil, Guyana, India, Libya, the Philippines, the Seychelles, Suriname and Zimbabwe and assisted governmental authorities and industrial enterprises.

A large number of project proposals have been elaborated covering possible future technical assistance based on the considerable experience of the Joint Programme in its areas of responsibility.

During its existence, the Joint Programme has published 185 titles embracing non-metallic raw materials, their up-grading and refining ceramics and other non-metallic products, energy conservation and management, environmental problems and application of non-metallic sorbents in agriculture.

Of particular interest and relevance to the countries planning future industrial utilization of specific non-metallic raw materials are publications which in a comprehensive way present the whole material cycle for a given mineral from the geological prospection of raw material deposits through the various stages of mining and processing to the final integrated industrial application. The distribution of the Joint Programme publications is executed by the Joint Programme and UNIDO's Industrial and Technological Information Bank (INTIB) and so far more than 100 governmental bodies and industrial corporations have been served in this way. The following titles, which are among those most frequently requested, illustrate the broad range of topics:

- Profiles of Brick Plants
- Simple Ceramic Manufacturing Equipment
- Art of Composing Wall Tile Bodies
- Energy Conservation in Non-metallic Minerals Based Industries
- Production and Application of Non-metallics in Agriculture
- Hydrophobic Perlite - Liquidation of Oil Products
- Prospecting and Exploration of Non-metallic Mineral Raw Materials
- Kaolin and its Utilization
- Calculations in Ceramics
- Waste Heat
- Manufacture of Washed Kaolin for Paper Industry
- Ceramic Glass

- Manufacture of High Alumina Products
- Manufacture of Laboratory Porcelain
- Heat Diagnoses made on Tunnel Kiln and Belt Drier
- Perlite Industrial Exploitation
- Advances in Materials Technology - Ceramics
- Glass Production Technology in Developing Countries
- Bentonite Complex Industrial Exploitation
- Industrial Exploitation of Graphites
- Multi-lingual Ceramic Vocabulary
- Trouble-shooting in Operation of Ceramic Kilns
- Measuring System and Evaluation on Ceramic Kilns
- Role of Perlite in Environmental Protection

The complete list also includes 43 lectures on industrialization, energy management and exploitation of non-metallics delivered by the Joint Programme staff during missions and technical workshops.

Special Activities

Long-term co-operation with specialized organizations in developing countries in the form of technical information transfer, arrangements for training, trouble shooting in existing industries and technical assistance can be achieved through twinning arrangements with the UNIDO-CSSR Joint Programme or, through the Joint Programme, with relevant institutions in Czechoslovakia. In total, 48 institutions and corporations from developing countries have requested consultations and closer co-operation.

The energy conservation programme attempts to respond to the needs of developing countries in various ways inclduing specialized individual fellowship training, specialized technical workshops of which two have already been held and raw materials testing leading to the elaboration of technologies with a special view to energy conservation. Two missions to Brazil and India oriented to energy conservation and management have been organized and 29 publications, five specialized short films concerned with energy in ceramics and a mobile diagnostic unit used for energy audits have been elaborated.

The Joint Programme has exposed the possibilities for application of non-metallics in agriculture of developing countries. A publication on "Production and Application of Non-metallics in Agriculture" was issued in 1983 and, as a result a group of experts from Egypt visited the Joint Programme and Czechoslovak Ceramic Works to study the Czechoslovak experience in agricultural applications of non-metallics. Follow-up activities in Egypt and several other countries as well as an Ad-hoc Expert Group Meeting on Production and Application of Non-metallics in Agriculture are under preparation.

Mineral sorbents applied in agriculture to reduce wash-out of chemical matters and hydrophobic expanded perlite applied to clean oil-polluted water contribute to the environmental protection. The Joint Programme has so far issued three specialized publications on the matter. Further, one mission to Kuwait and Qatar took place in order to demonstrate the effectiveness of hydrophobic expanded perlite for oil absorbtion and during an International Conference in Iran devoted to this subject, the technology in question was presented to a larger audience.

CONCLUSIONS

The Joint Programme operates in accordance with a work programme which is defined once a year by a Joint Committee with participation from both the Czechoslovak authorities and UNIDO Headquarters. However, this work programme has sufficient built-in flexibility to permit the introduction of new specific activities during the course of the year and the Joint Programme is, therefore, able to respond promptly to requests from developing countries for assistance of the types outlined in this booklet. However, whereas requests for information or publications or even, in some cases, for raw material investigations, can be satisfied directly by the Joint Programme in consultation with UNIDO, more comprehensive assistance and especially such which required international travel needs to be requested through the established Government and UN channels in view of the need for external financing.

The validity of this dual approach to co-operation with interested developing countires has been amply demonstrated by the rapidly increasing number of requests received for the services of the Joint Programme and continuous efforts are being made to strengthen and streamline its organization to allow it to respond to the growing needs.

ANNEX I

REVIEW OF ACHIEVEMENTS

1. Twinning Arrangements

The UNIDO-Czechoslovakia Joint Programme has established a twinning arrangement with a specialized institution in Suriname in the form of co-operation aimed at transfer of know-how, publications, arrangements for training and trouble shooting in existing industries. Twinning arrangements with Guyana, India, Libya and Egypt are being negotiated. In total, more than 40 institutions and corporations from the developing and least developed countries have requested consultations and closer co-operation.

The Joint Programme has established similar co-operation with Czechoslovak scientific organizations, universities, institutes and specialized enterprises to facilitate and accelerate any possible assistance to the developing and least developed countries in training technicians, testing raw materials, recruiting high qualified specialists and transferring technical information. Significant Czechoslovak organizations agreed to co-operate in this field:

Československé keramické závody, Praha (Czechoslovak Ceramic Works), trust of 9 ceramic companies and 2 research and designing institutes:
- Research Institute for Ceramics, Refractories and Raw Materials, Pilsen
- Projecting and Designing Institute, Prague
- West Bohemian Ceramic Works, Horní Bříza
- Ceramic Works, Chlumčany
- - Ceramic and Glass Raw Materials, Sedlec at Karlovy Vary
- North Bohemian Ceramic Works, Most
- Calofrig, Borovany
- Ceramic Works, Rakovník
- Moravia Chamotte and Schistose Clays Works, V. Opatovice
- Ceramic Works, Poštorná
- Ceramic Works, Košice

Přerovské strojírny, Přerov (Přerov Machinery)

Český geologický úřad, Praha (Czech Geological Office)

Československá keramika, Praha (Czechoslovak Ceramics, Foreign Trade Corporation)

Pragoinvest, Praha (Foreign Trade Corporation)

Polytechna, Praha (Technical Corporation Agency)

Cementárny a vápenky, Praha (Trust of enterprises producing cement and lime)

Keramoprojekt, Trenčín

Geoindustria, Praha

Československá akademie věd, Praha (Czechoslovak Academy of Sciences)

Further scientific institutions, universities, specialized enterprises and important corporations have also collaborated with the Joint Programme.

2. Individual Training

Experts in ceramic technology, energy conservation and in the manufacture of different non-metallic minerals based products and research managers were granted training in the Joint Programme, in the Research Institute for Ceramics, Refractories and Raw Materials in Pilsen and in pertinent Czechoslovak institutions and corporations:

1980 - one specialist from Bulgaria trained in "Art of Making Ceramic Glazes Decorative and Matt for Wall Tiles" - 2-month training

1981 - one specialist from Cyprus trained in the manufacture and application of bentonite - 2-month training

1982 - four specialists from the People's Democratic Republic of Korea trained in the manufacture of stoneware pipes and melted basalt - 2-month training

- one specialist from Kenya trained in the application of non-metallic raw materials - 2-month training
- one specialist from Brazil trained in new methods of energy conservation and management - 2-month training

1983 - one specialist from Brazil trained in energy conservation in ceramic industries - 6-week training

- two specialists from Guyana trained especially in the construction of rotary kilns and driers, production of refractories and in laboratory testing methods - 2-month training
- one specialist from Guyana trained in upgrading methods of non-metallic raw materials - 6-week training
- three specialists from Suriname trained in energy conservation and management - 3-week training

1984 - five scientists from Egypt trained in the use of bentonite in agriculture on 1 week training.

All the trainees had possibilities of consultations in production plants, specialized laboratories, technical schools, technical libraries of Czechoslovakia which could contribute to their training according to the training programmes adjusted to their occupations and special interests. The trainees elaborated final reports which regarded their training as satisfactory, especially, they pointed out the fact that they had been enabled to get acquainted in practice with any non-metallic raw material based production starting with extraction, production and ending with final application. In addition to it, they could see small scale production and also large automated plants during their short stay in Czechoslovakia. This was possible owing to the extraordinary concentration of silicate industries in West Bohemia whose centre is Pilsen.

3. Group Training

Before the Joint Programme was established, the In-plant Technical Workshop on the Production of Refractories, had been organized. The Technical Workshop on the Exploitation and Beneficiation of Non-metallic Minerals, Technical Workshop on Energy Conservation in Silicate Industries for the Least Developed Countries, Meeting on the Properties of Coating Kaolins and In-plant Technical Workshop on Energy Conservation and Management in Ceramic Industries were arranged by the Joint Programme hitting managerial issues of silicate and, if need be, non-metallic raw materials related industries, such as paper production. Participants were top governmental and corporation officials, experts and technicians from the developing and least developed countries.

The programme aimed at technological questions following the line from the extraction to the manufacture and final applications of non-metallics and a special attention was paid to the conservation and management of energies in the silicate industries. The last In-plant Technical Workshop on Energy Conservation and Management in Ceramic Industries was a consequence of the previous Technical Workshop on Energy Conservation in Silicate Industries as it had been required and recommended by the participants of the latter.

The group training was scheduled to provide for theoretical information delivered by top Czechoslovak and foreign experts and practical training in the institutes and corporations of Czechoslovak silicate industries. The horizontal discussions among participants from different countries on questions related to their industrial problems were regarded as a great contribution to solving them.

Some details on particular workshops are given below:

1980 - Technical Workshop on the Exploitation and Beneficiation of Non-metallic Minerals
/April 8 - 26/

- 15 participants from Botswana, Colombia, Cyprus, Egypt, Ethiopia, Ghana, India, Iran, Jordan, Nigeria, Suriname, Tanzania, Thailand, Turkey
- 14 lectures, 10 delivered by Czechoslovak experts and the other four by lecturers from Hungary, Great Britain, Austria and UNIDO Vienna
- Participants appreciated the Workshop as a very successful one and demanded its repetition on a larger extent and technical assistance of the Joint Programme in accelerating establishment of industries, training technicians, testing raw materials, short term expertise assistance, implementing energy measurements appliances and specialized laboratories and in providing with know-hows.

1981 - Technical Workshop on Energy Conservation in Silicate Industries for the Least Developed Countries
/October 5 - 16/

- 15 participants from Afghanistan, Bangladesh, Nepal, Somalia, Sudan, Tanzania and People's Democratic Republic of Yemen
- 11 lectures delivered by international experts, Czechoslovak science and research directors, university professors and factory senior technicians
- The programme was concentrated on three most energy intensive silicate industries - ceramics, glass and cement production

- The participants appreciated the workshop and demanded that the Joint Programme should go on in its activities and assist the least developed countries in energy conservation which had become a crucial issue of any further industrial development. They recommended the next technical workshop to be centered on energy conservation and management in ceramic industries only.

1981 - Meeting on the Properties of Coating Kaolin
/July 20 - 21/

It was arranged by the Joint Programme in the presence of Mr. M. Judt, UNIDO expert, and Czechoslovak specialists. The meeting contributed to clearing the existing problems in this area.

1983 - In-plant Technical Workshop on Energy Conservation and Management in Ceramic Industries for the Least Developed and Developing Countries
/April 11 - 29/

- 12 participants from Bangladesh, Ethiopia, Guinea-Bissau, Nepal, Sudan, Tanzania, People's Democratic Republic of Yemen
- 6 participants from Brazil, Guyana and Suriname
- 12 lectures delivered by international experts, industry and research directors, university professors and scholars
- The appreciation by participants, UNIDO representatives and Czechoslovak authorities of the technical level and organization was very positive.

4. Testing of Raw Materials

Testing of non-metallic raw materials from developing and least developed countries and the related activities such as geological survey, technological research, industrial verification, economic evaluation for decision making, elaboration of manufacturing technologies and their transfer, have represented a very important part of the technical assistance extended to these countries by the Joint Programme since its establishment.

The products based on non-metallic minerals are nowadays applied in heavy and light industries and to a great extent in the construction industry being thus indispensable for the balanced development of every national economy. The development of non-metallics based industries is one of the priorities in all the developing and least developed countries.

50 reports based on raw material tests, which has proceeded economically in dependence on the forthcoming or accomplished stages of pre-investment activities, have been elaborated. The preliminary, laboratory and pilot tests have involved the technological research and proposals of technologies. Many countries have made use of it:

Antigua, China, Costa Rica, Cyprus, Egypt, Ethiopia, Fiji,
Grenada Guyana, Jordan, Kuwait - Qatar, Libya, Nigeria,
Papua New Guinea, Seychelles, Suriname, Tanzania, Uganda
Zaire, Zimbabwe.

Specific instruction for developing countries regarding the testing of raw materials was published and distributed by the Joint Programme Bulletin no. 4 in 1982.

5. Technical Assistance, Advisory and Exploratory Missions

The Joint Programme taking advantage of the wide know-how of Czechoslovak ceramic industries has extended the direct assistance to the developing and least developed countries in all phases of decision process and in all stages of industrial exploitation of non-metallic raw materials. Participating in the UNIDO projects, the experts of the Joint Programme have visited many countries and assisted the governmental authorities and industrial corporations. In addition, the Joint Programme has mediated the access to know-how publishing on ceramic technologies, energy conservation and other technical issues related to industrial operations. 57 project proposals have been elaborated concerning technical assistance and submitted to relevant authorities.

a) Missions

Advisory missions were undertaken to the People's Republic of China, Syria and Libya in 1979 - 1980

in 1981 - advisory mission to Suriname oriented to the establishment of exploitation, beneficiation and processing of kaolin

in 1982 - exploratory mission to the Philippines for cottage small and medium size ceramic and glass industries

- advisory mission to Turkey concerning technical assistance to ceramic industry and application of diagnostic mobile unit, 3 lectures delivered on the occasion of 25th anniversary of the establishment of ceramic industry in Turkey

- advisory mission to Guyana oriented to formulating future co-operation in the field of non-metallic industries
- advisory mission to Suriname oriented to the evaluation of local non-metallic raw materials and follow-up actions
- advisory mission to Suriname to elaborate feasibility study on the establishment of ceramic wall and floor tile plant
- advisory mission to Libya concerning the industrial exploitation of local non-metallic raw materials

in 1983
- advisory mission to Zimbabwe geared to the expansion and diversification of ceramic industries and to the exploitation of non-metallic raw materials
- mission to Seychelles for technical assistance in the establishment of ceramic and heavy clay industries; geological prospection, pre-feasibility study and evaluation of suitability of raw materials
- mission to Middle East (Kuwait and Qatar) oriented to the liquidation of petroleum pollution of Persia Gulf
- mission to Brazil oriented to briefing on new diagnostic energy auditing methods and utilization of waste heat in ceramic industry
- mission to Libya for extension of ceramic industries
- mission to India for assistance in energy conservation in ceramic industries

b) Transfer of Know-how

During its existence, the Joint Programme has published 178 titles encompasing questions of energy conservation, preparation of decisions, research and testing of non-metallics, descriptions of industrial processes, ceramic vocabulary, bulletins, etc. (The cummulative list of Joint Programme publications is presented in Annex II).

Two main groups of publications deal with energy conservation and research activities respectively. The developing and least developed countries have appreciated the special approach in conducting series of publications. While all world publications are related specifically to particular industrial operations, such as raw material extraction, processing and application, the new Joint Programme approach is based on the information on individual minerals or rocks necessary for commercial and industrial application in developing countries, such as diatomaceous earth, clays, kaolins, etc. The new publication "Application of Non-metallic Minerals in Agriculture" was a result of this approach.

Apart from this title, the most required publications read inter alia as follows: Simple Ceramic Manufacturing Equipment, Art of Composing Wall Tile Bodies, set of publications dealing with energy conservation, Profiles of Brick Plants, Ceramic Vocabulary - Czech, English, German Version (Russian, French and Spanish version under preparation), Prospecting and Exploration of Non-metallic Mineral Raw Materials,Calculations in Ceramics, Waste Heat, Kaolin and Its Utilization, Manufacture of Washed Kaolin for Paper Industry.

Informative bulletins and booklets issued periodically and informing of the Joint Programme activities should be mentioned because they have evoked correspondence on technical matters between the Joint Programme and institutions in the developing and least developed countries. Requests for advising in the selection of most modern ceramic equipment and production methods, in research and testing methods, laboratory specialized equipment, different quality standards and other questions were answered by the Joint Programme.

Forty three lectures on industrialization and exploitation of non-metallics in the developing and least developed countries have been delivered by the Joint Programme staff during workshops, meetings, missions to the developing and least developed countries and other occasions to the concerned from the developing and least developed countries. All of them are filed in the Joint Programme archives and are for disposal to other countries.

6. Energy Conservation Programme

Energy conservation programme has fully responded to the needs of the developing and least developed countries. Based on the high level of energy conservation system in non-metallics in Czechoslovakia, the Joint Programme has extended various services to the developing and least developed countries providing individual and group training, elaborating energy saving ceramic technologies based on local raw materials, providing technical assistance during missions and publishing and lecturing on energy conservation and management. The assistance in energy conservation and management has covered six main spheres:

- non-traditional technologies with reduced energy intensity, such as the application of non-traditional raw materials as fluxes in body composition of ceramic products, the introduction of one-fire technology in firing walling products and the fast firing of various ceramic products
- optimization of thermal processes with regard to limiting conditions represented by acceptable temperature progress which is not detrimental to the quality of ceramic products and applicable in the manufacture of all ceramic products
- energy diagnostics of thermal equipment by means of energy and technological measurements (Mobile Diagnostic Unit)
- thermal equipment and its updating - involves repairs and improvements aimed at energy savings feasible by plant workshops and innovations, such as installment of more effective kiln furners and implementation of remedial measures recommended after diagnostic evaluation
- use of secondary heat resources involves the utilization of waste heat as from the kiln cooling zone, hot air outlet from driers and combustion products before the stack

f) mobile diagnostic unit

The backing Research Institute for Ceramics, Refractories and Raw Materials is in possession of three mobile diagnostic units which are prepared to conduct energy measurements in the developing and least developed countries. Relevant offers regarding implementation were elaborated and submitted which have not yet been exploited by the developing countries. This equipment has been, however, fully utilized for the purposes of individual and group training programmes. The implementation of the mobile diagnostic unit has always resulted into energy conservation, quality improvement of final products and higher outputs of driers and kilns.

7. Non-metallics in Agriculture

The Joint Programme has developed possibilities of the application of non-metallics in agriculture of the developing and least developed countries. The scientific efforts and practical experiments concerned with increasing agricultural output of soils in recent years have proved excellent properties of non-metallic minerals and rocks as bentonites, zeolites, tuffs and others when applied to soils as sorbents. The presence of sorbents in soils is regarded as important as photosynthesis for plant growing and their application to deficite soils increases the agricultural output. Sorbents added to fodder bring about the increased output of husbandry, too.

This issue is so important that a special Ad Hoc Expert Group Meeting "Production and Application of Non-metallics in Agriculture" is under preparation (Aide Memoire and Project Proposal submitted) to take place in Vienna and Czechoslovakia in 1985. The publication on "Production and Application of Non-metallics in Agriculture" by a team of authors came out in 1983. The Joint Programme iniciated the project proposal on soil reclamation by sorbents in Ethiopia which was submitted to UNIDO. Other projects are under consideration. Two groups of experts, one from the People's Republic of China in 1983 and the other from Egypt in January 1984 visited the Joint Programme and Czechoslovak Ceramic Works to study Czechoslovak experience in agriculture applications of non-metallics.

8. Non-metallics to Protect Environment

An important incidental circumstance of agricultural application of non-metallics is their positive influence on lowering the penetration of fertilizers and chemicals detrimental to the health into subsoil waters. The most valuable property of hydrophobic perlite to adsorb non-polar liquids and to repel water has been advantageously utilized in remedying petroleum polluted water reservoirs.

UNIDO special mission together with 3 Czechoslovak experts whose participation was financed by the Czechoslovak Authorities to Middle East geared to the solution of cataclysmatic situation of Arabian Gulf took place in 1983. Czechoslovak hydrophobic perlite was tested and evaluated very good filtering material because its utilization in filters in desalination plants made possible to use the water from the polluted sea. Other countries jeopardized by oil products pollution requested for assistance. The conclusions and recommendations were submitted to UNIDO considerations and implementations. Samples of Czechoslovak hydrophobic perlites were handed over, free of charge, to UNIDO for further testing on the spot. A follow-up of this project is necessary to be elaborated and further development followed to accelerate the suggested assistance.

9. African Industrial Development Decade

The Joint Programme has been expected to play a significant role in the African Industrial Development Decade due to the importance which is attached to the development of building materials industries. The Joint Programme has assisted to one third of African countries:

- Individual Training

One engineer from Kenya trained in the application of non-metallics;

Five scientists from Egypt trained in the application of bentonite in agriculture.

- Group Training

Participants from Botswana, Egypt, Ethiopia, Ghana, Guinea-Bissau, Nigeria, Somalia, Sudan and Tanzania took part in technical workshops organized by the Joint Programme.

- Raw Material Testing

Tests, analyses and technological evaluations of raw materials were carried out which were delivered from Egypt, Ethiopia, Libya, Nigeria, Seychelles, Tanzania, Uganda and Zaire.

- Technical Assistance

Missions were undertaken to Libya, Seychelles and Zimbabwe. Project proposals were elaborated to assist other African countries in ceramics, building materials and industrial and agricultural exploitation of non-metallics. Many African countries were sent technical publications, papers and advice on their special request, e.g. Mozambique on firing processes in the sanitary ware manufacture.

ANNEX II

C U M M U L A T I V E L I S T
OF THE UNIDO-CSSR JOINT PROGRAMME PUBLICATIONS
FOR THE PERIOD
1 October 1978 to 31 December 1983

JP/1/78	Clay Samples from the Caribbean Area - Technological Evaluation /Restricted/
JP/2/78	Questionnaire
JP/3/78	Ceramic Raw Material Testing Specification Sheet and Tentative Costs of Testing /Restricted/
JP/4/78	Clay Samples from the Caribbean Area /Restricted/
JP/5/78	Establishment of a Ceramic Pilot Plant in Botswana - Reduced Production Programme - Assessment of Feasibility /Restricted/
JP/6/78	Energy Saving Possibilities in Non-metallic Minerals Based Industries at Present and in the Long Run
JP/7/78	The Past-, Present-, Future Trend of Energy Savings in the Non-metallic Minerals Based Industry
JP/8/78	Clay Samples from Papua New Guinea - Technological Evaluation /Restricted/
JP/9/78	Kaolin and Its Utilization
JP/10/78	Energy Conservation in Non-metallics (Mobile Diagnostic Unit)
JP/11/78	Bentonite - Binding Clay
JP/12/78	Silica - Silica Raw Materials for Refractories, Ceramics, Glass and Building Materials
JP/13/78	Present-day Problems of Utilization of Gypsum Rock and Gypsum Plaster in the Building Industry
JP/14/78	Other Non-metallic Raw Materials
JP/15/78	Commercial Exploitation of Clays
JP/16/78	Dressing of Non-metallic Raw Materials
JP/17/78	Profiles of Brick Plants

JP/18/79	Geological Prospection and Exploration for Non-metallic Mineral Raw Materials
JP/19/79	Technological, Physical and Chemical Testing of Non-metallic Raw Materials
JP/20/79	Raw Materials from Suriname - Part I Technological Evaluation of Clay Samples /Restricted/
JP/21/79	Non-metallic Raw Materials - Source of Energy Conservation
JP/22/79	Brief Information on Micanite Manufacture, Properties and Use
JP/23/80	Field Operation of Mobile Diagnostic Unit /Restricted/
JP/24/80	Booklet 1979
JP/25/80	Booklet 1979 - Czech translation
JP/26/80	Anhydrous Sodium Sulphate Manufacture
JP/27/80	Energy Conservation in Non-metallic Minerals Based Industries
JP/28/80	Borosilicate Glass Tube Manufacture - Brief Information
JP/29/80	In-plant Training Guide - Kaolin, Clay, Feldspar and Diatomaceous Earth Deposits, Plant Visits and Sightseeing
JP/30/80	Exploitation and Beneficiation of Perlite - Perlite and Its Industrial Uses
JP/31/80	The Evaluation and Specification of Rock Deposits for Building Material Production: Limestones and Natural Pozzolanas
JP/32/80	Brief Description of Manufacturing Technology of Liquid Gold for the Decoration of Glass, China Ware and Ceramics
JP/33/80	Energy Conservation - Brief Information
JP/34/80	Survey of Values Applied in Energy Measurements (Mobile Diagnostic Unit) /Restricted/
JP/35/80	Recent Advances in Crude Oil Saving Systems in Petrochemical Industry
JP/36/80	In-plant Training Workshop on the Exploitation and Beneficiation of Non-metallic Minerals - Schedule

JP/37/80 In-plant Training Workshop on the Exploitation and Beneficiation of Non-metallic Minerals - Brief Information on Visited Plants

JP/38/80 In-plant Training Workshop on the Exploitation and Beneficiation of Non-metallic Minerals - Daily Reports

JP/39/80 In-plant Training Workshop on the Exploitation and Beneficiation of Non-metallic Minerals - Programme

JP/40/80 In-plant Training Workshop on the Exploitation and Beneficiation of Non-metallic Minerals - Conclusions and Recommendations /Restricted/

JP/41/80 In-plant Training Workshop on the Exploitation and Beneficiation of Non-metallic Minerals- Country Reports /Restricted/

JP/42/80 In-plant Training Workshop on the Exploitation and Beneficiation of Non-metallic Minerals - Final Report

JP/43/80 In-plant Training Workshop on the Exploitation and Beneficiation of Non-metallic Minerals - Final Report - Czech translation

JP/44/80 In-plant Training Workshop on the Exploitation and Beneficiation of Non-metallic Minerals - Final Report - Appendixes /Restricted/

JP/45/80 Raw Materials from Suriname - Technological Evaluation of Clay, Kaolin and Silica Sand Samples /Restricted/

JP/46/80 Simulating of Thermal Processes in Silicate Industries

JP/47/80 Decorating Colours for Glass, Ceramics and China Ware

JP/48/80 Clay Samples from Fiji /Restricted/

JP/49/80 Silvering Suspensions for Electrotechnical Industry and Electronics

JP/50/80 UNIDO Energy Task Force - UNIDO-CSSR Joint Programme Organization /Restricted/

JP/51/80 Review of the Joint Programme Publication for the Period - 1978 - VII/80

JP/52/80	Heat Consuming Units in Cement Industry
JP/53/80	Internal Script for Scientific Seminar UNESCO GEO - Nonmetallic 1979
JP/54/80	World Energy Problem
JP/55/80	Heat Consuming Units in Ceramic Industry
JP/56/80	Volcanic Rocks - Applied as Fluxes in Ceramic Manufacture
JP/57/80	Basalt Rocks
JP/58/80	Specification of Limestone and Kaolin Properties for Their Use as Fillers for Plastics
JP/59/80	Review of Publications
JP/60/80	Manufacture of Washed Kaolin for Paper Industry
JP/61/80	Equipment for Laboratory Testing of Kaolin, Clays and Sands
JP/62/80	Booklet 1980
JP/63/80	Booklet 1980 - Czech translation
JP/64/80	Liaison between the UNIDO Headquarters and the UNIDO-CSSR Joint Programme - Report /Restricted/
JP/65/80	Final Report on the Fellowship Training - Mrs. E. A. Stanulova, Bulgaria /Restricted/
JP/66/80	cancelled
JP/67/80	cancelled
JP/68/80	Simple Ceramic Manufacturing Equipment
JP/69/80	Low Cost Housing Industries
JP/70/80	Annual Report 1980 /Restricted/
JP/71/80	Annual Report 1980 - Czech translation /Restricted/
JP/72/81	Ceramic Processing Operations
JP/73/81	Final Report - Establishment of Small Scale Industries, Testing and Evaluation of Clay Samples from Zaire /Restricted/

JP/74/81	Art of Composing Wall Tile Bodies
JP/75/81	Bulletin No. 1
JP/76/81	Technological Tests of Suriname Kaolins /Restricted/
JP/77/81	Bulletin No. 2
JP/78/81	Non-traditional Ceramic Raw Materials Enabling Savings in Energy
JP/79/81	Non-traditional Ceramic Raw Materials Enabling Savings in Energy - Czech translation
JP/80/81	Non-traditional Raw Materials, Source of Energy Conservation
JP/81/81	Testing Institute and Plant Laboratories for Testing Non-metallic Raw Materials and Products
JP/82/81	Limestone Samples from Antigua - Chemical Analyses /Restricted/
JP/83/81	Final Report on the Fellowship Training "Bentonite Industry and Related Industries" /Restricted/
JP/84/81	Feasibility Study for the Commercial Exploitation of Kaolin Deposits in Gambia /Restricted/
JP/85/81	Project Concepts - World Bank, Islamic Bank and OPEC Financing
JP/86/81	Applied Mineralogy and Washing Tests of Suriname Kaolins /Restricted/
JP/87/81	Heat Consuming Units in Glass Industry
JP/88/81	Diagnostics
JP/89/81	General Consideration on Energy Consumption in Silicate Industry
JP/90/81	Recent Advances in Crude Oil Saving Systems in Petrochemical Industry
JP/91/81	Ceramic Industry - Reducing the Energy Requirements in Technological Processes
JP/92/81	Assistance in the Establishment of Clay Products and Non-metallic Materials Industries in Botswana /Restricted/
JP/93/81	Save the Heat - Draft Synopsis for the UNIDO film
JP/94/81	Industrial Exploitation of Phonolites

JP/95/81	Final Report - Technical Workshop on Energy Conservation in Silicate Industries
JP/96/81	Final Report on the Fellowship Training - Mr. S. Kassinis, Cyprus /Restricted/
JP/97/81	Testing of Bentonite Samples from Cyprus /Restricted/
JP/98/81	Anorganische nichtmetallische Rohstoffe und ihre Rolle bei de Energieeinsparung
JP/99/81	Suriname Kaolins, Beneficiation and Industrial Applicability Tests, Evaluation of Results /Restricted/
JP/100/81	Evaluation of Cyprus Bentonite for Wall Tile Manufacture /Restricted/
JP/101/81	Czechoslovak Ceramic Works, Their Development, Structure and Energy Management
JP/102/81	Cement Industry - Reducing the Energy Requirements in the Technological Processes
JP/103/81	Annual Report 1981
JP/104/81	Pozzolanic Activity Tests of Uganda Laterite Sample /Restricted/
JP/105/81	Energy Saving in the Glass Industry
JP/106/81	Energy Conservation Programme in Czechoslovak Silicate Industries
JP/107/81	Annual Report 1981 - Czech translation
JP/108/81	Terminal Report - Suriname /Restricted/
JP/109/82	Glass Melting Pots /Restricted/
JP/110/82	Booklet 1981
JP/111/82	Bulletin No. 3
JP/112/82	Terminal Report - Philippines /Restricted/
JP/113/82	Industrial Beneficiation and Processing of Diatomaceous Earth
JP/114/82	Pozzolanas and Their Application in Binding Material Manufacture
JP/115/82	Road Construction

JP/116/82	Crystal Glass Technology Based on Suriname Sands /Restricted/
JP/117/82	Bulletin No. 4
JP/118/82	Bulletin No. 5
JP/119/82	Prospecting and Exploration of Non-metallic Mineral Raw Materials
JP/120/82	Vocabulary for Ceramic Industry and Non-metallic Raw Materials
JP/121/82	Review of Activities of the Joint Programme for the first half-year 1982
JP/122/82	Mining and Dressing of Kaolin in the CSSR
JP/123/82	Sanitary Ware Manufacture (Techno-economical information)
JP/124/82	Czechoslovak Ceramic Works - Development and Energy Conservation
JP/125/82	Non-metallics - their Contribution to Energy Conservation
JP/126/82	Energy Management in a Ceramic Plant
JP/127/82	Energy and Material Flows in the Manufacture of Selected Ceramic Products
JP/128/82	Energy Savings in Composing Ceramic Bodies
JP/129/82	Calculations in Ceramics
JP/130/82	Progressive Kilns and Driers - Source of Energy Conservation
JP/131/82	Measuring Instruments Installed in Ceramic Plants
JP/132/82	Diagnostic Mobile Unit
JP/133/82	Waste Heat
JP/134/82	Investment and Production Costs of Industrial Units
JP/135/82	Guide to the Technical Workshop on Energy Conservation in Silicate Industries
JP/136/82	Application of Non-metallic Minerals in Agriculture

JP/137/82	Final Report on Fellowship Training - Mr. W. Wa Kabecha, Kenya /Restricted/
JP/138/82	Determination of Pozzolanic Activity of Samples from Tanzania /Restricted/
JP/139/82	Exploitation of Non-metallics in Agriculture
JP/140/82	Manufacture of Refractories from Kyanites
JP/141/82	Suriname Kaolins - Moengo Locality /Restricted/
JP/142/82	Establishment of Ceramic Tile Plant - Feasibility Study - Libya /Restricted/
JP/143/82	Final Report on Felowship Training - Mr. J. Duailibi Filho, Brazil /Restricted/
JP/144/82	Annual Report 1982 /Restricted/
JP/145/82	Terminal Report - Libya /Restricted/
JP/146/82	Terminal Report - Suriname /Restricted/
JP/147/83	Kaolin from Nigeria /Restricted/
JP/148/83	Application of Bentonite to Agriculture of Desert Countries - Preliminary Evaluation
JP/149/83	Production and Application of Non-metallics in Agriculture
JP/150/83	Booklet 1982
JP/151/83	Hydrophobic Perlite - Liquidation of Oil Products Preliminary Information
JP/152/83	Exploitation of Non-metallics in Agriculture
JP/153/82	Terminal Report - Zimbabwe /Restricted/
JP/154/83	Clay Samples from Seychelles /Restricted/
JP/155/83	Final Report on Fellowship Training - Mr. A. B. de Queiroz, Brazil /Restricted/
JP/156/83	Final Report - In-plant Technical Workshop on Energy Conservation and Management in Ceramic Industries
JP/157/83	Production of Alumina from Non-bauxitic Raw Materials

JP/158/83	Semi-annual Report 1983 /Restricted/
JP/159/83	Summary of Semi-annual Report 1983 /Restricted/
JP/160/83	Final Report on Fellowship Training - Mr. V. Samarakone, Mr. R. A. Rodrigues, Guyana /Restricted/
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JP/168/83	Ceramic Glazes
JP/169/83	Terminal Report - Libya /Restricted/
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JP/171/83	Bulletin No. 6
JP/172/83	Heat Diagnoses Made on Tunnel Kiln and on Belt Drier
JP/173/83	Perspective Industrial Exploitation of Mineral Raw Materials
JP/174/83	Terminal Report - India /Restricted/
JP/175/83	Glass Raw Materials from Uganda /Restricted/
JP/176/83	Industrial Exploitation of Graphites
JP/177/83	Booklet 1983
JP/178/84	Analysis of SiC Materials Applied to a Muffled Tunnel Kiln Producing Sanitary Ware in Gariam (Libya)/Restricted/

Distr.
LIMITED

UNIDO/IO.539
30 July 1984

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

ENGLISH

Meeting of the Advisory Panel
on Preventive Medicine
Vienna, Austria

27-28 February 1984

PROGRAMME FOR THE INDUSTRIAL PRODUCTION OF BIOLOGICALS (IPB)

Brief presentation by the UNIDO Secretariat*

prepared by
Pharmaceutical Industries Unit
Chemical Industries Branch
Division of Industrial Operations

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V.84-88890

In 1977 it was estimated that less than 10% of the children born each year in the developing countries received immunization[1]. Since then the Expanded Programme on Immunization (EPI) of WHO has been progressing quickly and by the end of 1983 approximately 44% of the children born were immunized globally. This immunization coverage is less than 30% in the developing countries at present[2]. If this trend should continue the EPI will achieve its goal by 1990, that is providing immunization for all children against diphtheria,measles, poliomyelitis, tetanus, tuberculosis and whooping cough.

The higher the coverage the higher the cost of EPI. The programme required US$ 72 million in 1981 however it will cost around US$ 300 million by the end of the decade. From this figure at least one third will come from the international community by donation[3].

It is a well established fact that to control the above referred childhood diseases, immunization is the most economical solution. However to ensure that enough vaccine is available to immunize the 100 million or more children who will be born each year by 1990 and onwards, the present vaccine production and quality control capacities would need to be increased. However many participants of the 2nd Consultation on the Pharmaceutical Industry felt that there was no need to set up new production capacities for vaccines since there was ample world capacity to meet current and anticipated demand in the near future[4].

Does this mean that the developing countries, with a well established delivery system for immunization and certified quality control facilities for biologicals should be dependent indefinitely on imports and donations?

1_ Progress Report by the Director General, EPI, WHO, WHA 30, A30/13, 1977

2_ Immunization Health and Development, WHO, WPR No. 19, 1983

3_ Report of the EPI Global Advisory Group Meeting, WHO, EPI/GEN/81/12

4_ UNIDO, ID/311, p. 121, 1984

Does this mean that the present industrial capacity can cope with an increase in demand of approximately 300% without additional investment? Can the United Nations Agencies and Organisations give an assurance that the present pricing of vaccines and the donations required can also be provided after 1990 when the present demands of developing countries shall have tripled?

Or could it be envisaged that this increased demand will drop in consequence of control of at least some of the above referred diseases? If so, would it allow the deployment of resources to control some further prevalent diseases by introducing immunization with any recently developed vaccines?

Obviously WHO/UNICEF also faced the same questions and therefore already in 1977, in his Progress Report, the Director General of WHO stated and I quote:

> "UNIDO should be stimulated to take a greater interest in vaccine production in the developing world as a part of its involvement in developing the manufacture of medicine in these countries" unquote[1]

UNICEF has also taken action to develop a special support programme for primary health care so called GOBI, with low cost methods of growth monitoring, oral rehydration therapy, breast feeding and immunization.

In 1982 WHO was still preoccupied with the possible shortage of vaccines not only with regard to the EPI programmes but also the general goal of "Health for All" and therefore WHO has emphasized the need for production of vaccines in developing countries since their supplies will be critically limited in the near future[5].

Based on the above it is obvious that UNIDO has to develop its own programme for production of biologicals. Even the delayed reaction of UNIDO might be beneficial for the implementation of such a programme since the accelerated EPI programmes have already established the delivery system for vaccines in many developing countries and at the same created a market for these products. Other elements of the EPI such as establishing immunization centres, training of manage-

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5_ A compendium of WHO's collaborative activities with the United Nations System, WHO, CWO/82.2.

ment and personnel for the programme, increasing social acceptance of immunization and last but not least, establishing and certifying national or regional quality control facilities, have utmost importance. To promote regional self-reliance is also one of the long-term objectives of EPI.[6] However while the domestic vaccine production is only one of the targets of EPI, it should be the central preoccupation of UNIDO based on the recommendations of the 2nd Consultation on the Pharmaceutical Industry[7] and the increased number of requests received from developing countries for Technical Assistance in establishing production units for biologicals. UNIDO's intention is to provide developing countries with all the relevant techo-economic information for establishing industrial production of biologicals. In this regard the main elements will be the assessment and choice of available technologies giving due importance to factors such as production strains, raw materials and equipment required; the quality, reproductibility and the cost of the product; the staff and infrastructure requirements; the minimum/maximum technical and economic scale of production and the investment required. The selected technology should be suitable for the recipient country depending on its level of development and capability to assimilate it.

To fulfil this task, UNIDO would like also to clarify the methodology of implementation. Consequently it is UNIDO's aim to collect and process information, to prepare directories of supply for raw materials, biologicals and even technologies,to prepare model programmes as guidelines for developing production facilities.

However by establishing IPB, UNIDO is not aiming to reach the EPI's target percentage-wise. The EPI's main target is to achieve 100% coverage of immunization, obviously IPB does not intend to establish such an industrial capacity in developing countries which could meet the entire demand of the Third World. UNIDO's intention is only to implement case projects and through this to demonstrate that developing countries if desired can reach a relative self-reliance in biologicals upon adopting an industrial approach. In this connection co-operation with WHO/UNICEF will be of great importance and benefit to the developing countries. This co-operation will reflect the already existing co-operation between UNIDO and WHO.

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6 _ Progress Report by the Director General EPI, WHO, WHA 30 A 31/21 1978

7_ UNIDO, ID/311 p.10-12 1984

In order to achieve success in this programme, the distinguished members of the Advisory Panel are invited to advise UNIDO on the following :

(a) Establishing an illustrative list of biologicals.

(b) Identifying criteria for industrial technology for the production of biologicals by characterising its main technical and economic aspects.

(c) Sources of technology and transfer of technology.

(d) Steps to be taken concerning implementation of the IPB programme such as the carrying out of surveys for collection of information, organising Advisory Expert Group Meetings, implementing case projects at different techno-economic levels in Africa, Asia and Latin America.

(e) Co-operation among UN agencies and organisations, bilateral agreements and TCDC.

(f) Specific guidelines for implementation of the recommendations of the 2nd Consultation on the Pharmaceutical Industry.

(g) Responsibilities and committments for the implementation of the IPB.

The Secretariat trusts that this meeting will be carried out in a most cordial and co-operative atmosphere for the benefit of the developing countries.

Distr.
LIMITED

UNIDO/IO.590
31 July 1984

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

ENGLISH

Meeting of the Advisory Panel on
Preventive Medicine
Vienna, Austria

27-28 February 1984

UNIDO PROGRAMME FOR INDUSTRIAL PRODUCTION OF BIOLOGICALS

(IPB)

An introductory paper *

prepared by
Pharmaceutical Industries Unit
Chemical Industries Branch
Division of Industrial Operations

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INTRODUCTION: UNIDO'S INTENTION TO CONTRIBUTE TO THE PREVENTIVE MEASURES OF THE PRIMARY HEALTH CARE.

1. At present, the health state of hundreds of millionsof people throughout the world can be regarded as unacceptable. Approximately half of the world's population does not have the benefit of adequate health care. The 30th World Health Assembly therefore decided already in 1977 that by the year 2000 all people in all countries should have a state of health that will permit them to lead a socially and economically productive life. 1/2/ Health for all, however, does not obviously mean that in 2000 professional health personnel will provide medical care for everybody and it does not mean that by 2000 nobody will be sick or disabled. But it does mean that better approaches will be used than they are used today for preventing disease and alleviating unavoidable disease and disability. Since about 750 million people live in the world in hunger and poverty and if current trends continue this situation will not significantly improve by the year 2000, it has serious adverse effects to the state of world health. 3/ At present, 65 developing countries spend less than US$ 8 of public funds per capita per annum on health. 4/ To overcome those obstacles which are working against achieving the goals of "Health for all by the year 2000", one of the economically most feasible alternatives is to strengthen the preventive side of medical care at the level of primary health care.

2. The primary health care as the first level contact with the national health system should bring health care as close as possible to where people live and work. However, approximately half of the world population is not even within walking distance (10 km) of a national health facility of any kind. To promote the primary health care in developing countries but in particular in the least developed countries is therefore an absolute necessity.

1/ Resolution WHA 30. 43, 1977

2/ Health is "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity". Constitution of the WHO, Basic Documents, 15th edition, 1961.

3/ Brandt Commission, North-South: a programme for survival, Pan Books, London, 1980.

4/ Assessing the march towards health for all, WHO, 1983.

The primary health care includes at least:

- Health education
- Adequate supply of food, safe water and sanitation
- Maternal and child health care
- Immunization against the major infectious diseases
- Preventive care of locally endemic diseases
- Curative care of common diseases and injuries and
- Provision of essential drugs. 5/

The above activities of primary health care are in many senses overlapping and therefore no sound distinction can be drawn between sanitation, preventive medicine, curative medicine, health promotion and improvement of standards of living. 6/

3. The preventive side of primary health care includes different activities such as:

- Health education and training
- Health surveillance (epidemiology)
- Processing of information
- Preventive diagnostic measures
- Adequate food supply and proper nutrition
- Adequate supply of safe water and basic sanitation
- Provision of oral rehydration salts (ORS)
- Chemoprophylaxis (programme on essential drugs)
- Immunization and
- Seroprophylaxis, etc.

Many UN, governmental and non- governmental agencies make their contribution to carrying out the above activities in assisting the developing countries, however, whatever contribution is made, it shall meet the requirements of WHO. Since UNIDO's mandate is to assist in the industrialization of developing countries, the industrial inputs to the preventive medicine should be regarded as a particular contribution of UNIDO to the primary health care. The above UNIDO assistance has its impact not only on the public health but also on the socio- economic conditions of developing countries.

5/ Alma -Ata 1978, Primary Health Care, WHO, 1978

6/ C.-E.A. Winslow, The cost of sickness and the price of health, WHO monograph, no. 7, p. 28, 1951

4. To achieve the goals of "Health for all by the year 2000", UNIDO does not only intend to provide industrial inputs to the preventive side of the national primary health care programmes but for several years has started to assist in creating national industrial capabilities of developing countries by collecting industrial information, training of personnel and developing manufacturing units for essential drugs (chemoprophylaxis), vaccines,blood products (sero-prophylaxis) and oral rehydration salts. It should be noted that UNIDO has already carried out an extensive programme for the production of pharmaceuticals through its technical assistance programme, prepared studies and organized consultation meetings on the pharmaceutical industry. UNIDO has now decided to extend its operation into that particular field of pharmaceutical industry which will provide biologicals to the national primary health care programmes. The scope of the present paper is therefore focused only on the industrial aspects of the manufacture of biologicals, namely immunologicals and blood products.

VACCINES IN THE PRIMARY HEALTH CARE PROGRAMMES: THEIR ECONOMICS AND DELIVERY

5. The analyses of the cost-effectiveness and cost-benefit of vaccines show that immunization programmes against infectious diseases can be among the economically most feasible investments available to developing countries. There is no doubt that the prophylaxis, that is vaccination against those childhood infectious diseases included in the Expanded Programme on Immunization (EPI), has clear advantage over the therapy according to the cost-benefit analyses.

The total costs of the immunization programmes include:

- Capital costs: buildings
  vehicles
  cold-chain
  spare parts, etc., and
- Operating costs: salaries and allowances
  training
  transportation (immunization team travel, fuel, vehicle maintenance, vaccine shipment)
  vaccines and

other operating costs (cold-chain maintenance, electricity/kerosene, jet-injector maintenance, etc.) 7/

There are five main categories of gain from immunization:

- Savings in treatment costs following reduced incidence of disease.
- Reductions in mortality.
- Reductions in morbidity.
- Avoidance of "intagible" costs such as suffering of pain and anguish of illness both of the patients and their families, etc., and
- Supplementary benefits such as strengthening managerial capabilities of national health services, establishing the infrastructure capable of administering new vaccines as they become available, etc. 8/

Valuing a life-saving activity is the most controversial part of cost-benefit analysis in planning of health care programmes. If the value of human life in developing countries were regarded as negative then it seems to be no economic justification for life-saving health programmes. But it is an extreme view, based on a questionable approach to the valuation of human life which naively equates economic welfare with gross national product. There are at least three different approaches to the valuation of life:

- the human capital method is based on the years of life gained from immunization, and therefore gives a lower value to life where formal employment opportunities and salaries are lower as in developing countries.
- Representative samples of population are questioned about there willingness to pay for reduction in the risk of death.
- Actual values of human life obtained from similar decision in the past can be used. 9/

According to the analyses there are immunization programmes which are not only cost-effective, but also save money, they provide net health benefits and reduce net medical costs. Other programmes intended

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7/ Costing guidelines, WHO, EPI/GEN/79/5, 1979

8/ A.L. Creese & R.H. Henderson, Cost-benefit analysis and immunization programmes in developing countries, Bull. WHO, 52, 491-497, 1980.

9/ Cost effectiveness and cost benefit analysis of immunization programmes in developing countries, IFPMA Document, SV 67, p.38, 1983

primarily for specific groups of individuals are cost-effective because they improve the share of health at a low cost, however, these do not result in net medical savings.

6. The results of the cost-benefit and cost-effectiveness analyses of immunization programmes should be regarded as estimates since both the costs and benefits have fixed and variable components, however, the influential factors of the variable costs are different from those of the variable benefits.

Fixed costs can be defined as those expenses which are required to develop and operate a programme of a given capacity. In absolute terms the variable costs depend directly on the number of vaccinations administered during a given period. In relative terms, however, this relationship is indirect, the higher the number of vaccinations administered during a given period , the lower the ratio of the variable costs.

Substantial savings can be achieved by bulk purchases if they can be established on the basis of regular contracts. As much as 500 to 600 per cent savings have been reported by bulk purchases. 10/ The other main component of the variable cost is the intra-country variation. High unit costs in thinly populated rural areas may make immunization against a single infectious disease uneconomic. But since the costs of vaccines represent about or even less than 20 percent of the total costs in the case of EPI vaccines, simultaneous immunization against several diseases provides an economically more feasible alternative for small additional expenses. 11/

10/ P. Carrasco & W. Umstead, EPI in Americas: Benefits from revolving fund, WHO Chron, 37, 81-85, 1983.

11/ M. Rey, Simultaneous administration of vaccines, killed or live, Proc. Int. Conf. Application of Vaccines against Virae, Rickettsial, and Bacterial Diseases of Men, PAHO, p. 407-412, 1971.

It should be however, noted that the distinction between fixed and variable costs is not hard. The global estimate of WHO for an average unit cost, that is the cost for fully immunized infant was approximately US$ 3,00 in 1980, the same value increased to US$ 5,00 by 1983, but the costs of vaccines remained around the same value, that is close to US$ 1,00. 12/ The high inflation rate has not affected the costs of vaccines, however, the costs of delivery have significantly increased.

Finally it is worth to be mentioned that the average unit cost of US$ 5,00 does not include the private costs such as travel expenses and lost work or leisure time of those who attend the vaccination centres.

The main variable component of the benefit side is the value of human life. Depending on the assumptions chosen there can even be a 20-fold difference between the estimated extremes. 13/

The economic evaluation of immunization programmes have recently been carried out in detail by different authors. 14/15/16/

12/ 1984 EPI Revolving Fund Prices, EPI Newsletter, Vol. V, No. 6, p.6-8, 1983.

13/ W.M. Makinen, A social cost-benefit analysis of aunti-measles vaccination in Yaounde, Cameroon, Ph.D. dissertation, University of Michigan, 1979.

14/ A.L. Crease et.al., Cost-effectiveness appraisal of immunization programmes, Bull. WHO, 60, 621-632, 1982.

15/ A. Crease, The economic evaluation of immunization programmes in The economics of health in developing countries, ed. K. Lee & A. Mills, Oxford University Press, 1983.

16/ Prospects for production of vaccines and other immunizing agents in developing countries, UNIDO/IS.402, 1983.

7. In most immunization programmes, as soon as those children within easy reach have been immunized, a greater coverage can usually be obtained only at a higher average unit cost. It can generally be stated that the greater the coverage the higher the average unit cost. However, it is possible to estimate the optimal combination of different approaches that is the use of fixed units, outreach units and mobile units for delivery of vaccines. 17/

One of the most difficult parts of an immunization programme is keeping the vaccine cold during its shipment from the manufacturer to the vaccinee. In a typical vaccine cold chain close to half of the refrigerators and freezers are out of order. 18/

The EPI makes great efforts to improve immunization coverage but it is an extremely difficult task in developing countries. In these countries but in particular in the least developed countries many obstacles have to be overcome during establishing a vaccine delivery system at the managerial, operational and control level. The social acceptance of vaccination is also very low in several developing countries. 19/ In 1983 the immunization coverage was approximately 30 % in developing countries. 20/

HOW TO PRODUCE CONVENTIONAL VACCINES RECOMMENDED FOR USE IN THE EPI IN DEVELOPING AND LEAST DEVELOPED COUNTRIES: MANAGEMENT, TECHNOLOGY, INVESTMENT.

8. For about 30 years many efforts have been made by different UN, governmental and non-governmental agencies and organisations to develop the manufacture of vaccines in developing countries. However, with some exceptions these efforts have failed. Analysing these projects one can identify the most important influential factors which have had their negative effects throughout the implementation and also in the operation resulting in wastage of efforts, time and funds and causing concern and frustration.

17/ K. Lee, Resources and costs in primary health care, in The economics of health in developing countries, ed. K. Lee & A. Mills, Oxford University Press, 1983.

18/ J. Cheyne, Strengthening the vaccine cold chain, World Health Forum, 3, 436-440, 1982.

19/ ICDDRB, Dhaka, Bangladesh, Scientific Report No. 43, 1981.

20/ Immunization, Health Development, WHO, WPR, No. 19, 1983.

Suggestions for successful establishment and operation of manufacturing facilities for vaccines in developing countries have been given in the issue and background papers prepared for the Second Consultation on the Pharmaceutical Industry, Budapest, Hungary, 1983. 21/22/

Many participants to the Second Consultation supported the proposals contained in the issue paper on "The manufacture of vaccines in developing countries". 21/ These participants acknowledged the importance of quality control as even the imported quality vaccines were subject to deterioration during shipment and distribution. Many participants felt that there was no need to set up new production capacity to meet current and anticipated demands in the near future. Further, they suggested that developing countries should first establish national quality control facilities for biologicals and the necessary infrastructure for national vaccination programmes. Finally, they suggested that in case governments of developing countries desired to enter into domestic vaccine production, they should do so in a gradual way by stages, from the checking of imported vaccines to importing concentrated vaccines for blending, filling and packaging to producing domestic vaccines. A number of participants, in support of issues expressed their readiness to provide technology for a wide range of biologicals, such as human and veterinary vaccines and blood products, while several other participants expressed their readiness to transfer technology and offer training on a bilateral basis. 23/

The Second Consultation gave the following recommendations on the subject:

- Use the distinction of classical and modern vaccines for practical purposes as classified in ID/WG.393/12/Rev.1 21/ (see annexure A)
- Consider the addition of vaccines, sera (both for human and veterinary use) and immunoglobulins to the existing biologicals in the UNIDO illustrative list; 24/

21/ The manufacture of vaccines in developing countries, issue paper, UNIDO, ID/WG.393/12/Rev. 1, 1983

22/ The manufacture of vaccines in developing countries, Background paper, UNIDO, ID/WG.393/13/Rev. 1 1983.

23/ Second Consultation on the Pharmaceutical Industry, Budapest, Hungary, 21 - 25 November 1983, Report, UNIDO, ID.311, p. 53-54, 1984.

24/ Progress report of activities taken on consultations on the pharmaceutical industry, Annexure A, UNIDO, ID.WG 393/5,1983.

- Adopt a step-by-step approach for establishing control and production capability of vaccines in two ways: (i) From filling and packaging towards actual manufacture; (ii) from production of classical vaccines towards modern ones;
- Implement long-term continuous technical assistance and support programmes for effective assimilation of technology and control procedures to be transferred;
- Promote the transfer of technology for modern vaccines at national and regional levels where there is adequate technical infrastructure; and
- Promote the manufacture at regional level of certain biologicals other than vaccines that are either difficult to procure or only used in developing countries. 25/

9. Depending on the actual stage of infrastructure of the public health and industry in developing countries, facilities for blending, filling and packaging of bulk vaccines or actual manufacture of vaccines can be established. For the least developed countries the establishment of a blending, filling and packaging unit is a realistic target, while developing countries with solid public health infrastructure and capabilities in the pharmaceutical industry can develop actual manufacture of conventional vaccines. A few more advanced developing countries can enter into the production of modern vaccines. It should be emphasized, if a developing country reached a certain stage, it does not mean that it might automatically enter into the next stage, since the period of each stage even with a continuous technical assistance and support programme can be extended for improving the quality of products and the economic viability of the manufacturing unit.

The basic requirements for manufacture of vaccines in developing countries are as follows:

- National pharmaceutical policy: drug policy and pharmaceutical industrial policy;
- National vaccination policy;
- National control authority and national control laboratory;
- Reliable epidemiological data regarding diseases preventable by immunization;
- Techno-economic feasibility studies and preparatory assistance;

25/ UNIDO, ID/311, p. 11-12, 1984

- Production programme and capacity data;
- Market data: raw materials, bulk vaccines, auxiliary materials, packaging materials, equipment and spare parts, technologies, patents, potential domestic and export market;
- Site of construction;
- Building;
- Technology;
- Trained personnel at managerial, professional and labour level: number and qualifications;
- Logistics: Network for collection of raw materials for blood products and for distribution of finished products, and
- Investment.

The main technical elements of production and quality control facilities for vaccines are given according to the requirements of WHO.[26/] (See annexureB)

10. In case governments of the least developed countries desire to enter into domestic vaccine production they should do so in a gradual way by stages. The first stage must be the creation and the running of a validated national quality control facility and a national quality assurance programme. The second could include the transfer of technology of vaccine blending, filling and packaging. A precondition for that type of technology transfer is often the purchasing of bulk vaccine from the technology supplier. Actual manufacture as a starting step does not seem to be a realistic target for the least developed countries. Since the technology is generally available at this stage, the implementation of such projects requires assistance mainly in management and investment. As a preliminary stage the setting up of an infusion and reconstituting fluids plant could be crucial in order to assure the transfer of technology for the water treatment process and sterile operation.

11. The main elements of the implementation of the projects and the ways and means of the recommended technical and financial assistance are as follows:

11.1. The prerequisite for the development of this particular subsector of

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26/ Manual for the design, equipping and staffing of facilities for the production and quality control of bacterial vaccins, WHO, BLG/UNDP/78.1

pharmaceutical industry is the government's promoting policy.
The policy should be established and can be referred to as pharmaceutical policy, which includes besides the drug policy, the pharmaceutical industrial policy. No foreign assistance is required in this phase.

11.2. Based on the national health policy but also on the pharmaceutical policy, the national vaccination policy can be formulated. The vaccination policy includes the immunization schedule and the operational plants. The immunization schedule must be epidemiologically relevant, immunologically effective, operationally feasible and socially acceptable. The operational plans should assure the highest possible coverage of target population, fixed immunization centres and mobile teams. 27/ In this phase a foreign expert, epidemiologist may assist the Government.

11.3. National control authority should be established by the Ministry of Health. The national control laboratory providing the necessary technical services to the national control authority should be also established. The national control authority licenses the manufacturers and their products in the country. The national quality assurance programme is established and controlled also by the above authority. In many cases the director of the laboratory may be the legally empowered authority. 28/ Foreign export in quality control of biologicals may assist the Government in this phase.

11.4.Continuous epidemiological surveillance should be organised and carried out with particular relevance to diseases preventable by immunization.
A foreign expert, epidemiologist may assist the Government in this phase.

11.5. Proposal for production programme and determination of the capacity is given by a foreign expert in production of biologicals to the Government.

11.6. Based on the market research, a techno-economic feasibility study should be prepared to determine the technically and economically most advantageous alternative for investment. In this phase a group of experts (e.g. production, quality control and marketing experts) should assist local counterparts.

27/ Expanded programme on immunization, programme design, WHO, EPI/G.77.1
28/ The national control of vaccines and sera, WHO Techn. Rep. Ser.,658, 1981.

11.7. Selection of size and location for construction. No foreign assistance is required in this phase.

11.8. Selection of technology by a foreign expert in production assisting local counterpart.

11.9. Architectural, mechanical and engineering designs should be prepared in accordance with the Good Manufacturing Practices (GMP). In this phase foreign experts (architect and engineer) may assist the Government.

11.10. Tendering of conditions for execution of the project can result in different agreements as follows: project execution by the technology recipient, implementation of work by a single, independent contractor, implementation of work by a group of contractors of different origin. No foreign assistance is required in this phase.

11.11. Based on the designs, the construction and engineering work is carried out. It should be assured that the capacity of the unit can be increased without major remodelling and/or the premises can be extended with minimum investment when it is necessary. Sources of financing should be identified.

11.12. The project management should be appointed.

11.13. The recruitment and training of personnel for production and quality control should be launched as soon as the construction work has started. Foreign experts, expatriates, local professionals and technicians can be recruited. The training of personnel can be carried out in independent institutions or in the premises of the technology recipient or supplier.

11.14. For purchase of equipment and spare parts for installation of equipment to perform the trial runs and to produce and control the trial batches, foreign experts in production and quality control can be contracted.

11.15. For purchase of bulk vaccines, packaging materials and laboratory animals, sources of supply should be identified. Quality control expert may assist the Government in this phase.

11.16. For the establishment of technical infrastructure the following utilities are required: electric supply, stand-by emergency generator, water supply, drainage and gas supply. In many developing countries it may happen that public utilities do not exist on the site selected for the construction of production facility. In this case there is an option between extending the municipal public utilities to the site of manufacturing plant and establishing them independently. No foreign assistance is required in this phase.

11.17. The logistics for distribution of the products manufactured should be established. Assistance in organisation and funds may be required.

11.18. Sources of financing should be identified. Alternative sources of financing can be: Government's budget, funds of UN organizations and agencies, bank funds, donations, etc.

12. Both professional and labour staff should be highly motivated and disciplined because only this behaviour can assure that during the routine work, the aseptic and sterile conditions will as far as possible be kept. The importance of the above cannot be overemphasized since vaccine production at any stage is based on aseptic and sterile work. Familiarizing with the aseptic and sterile work needs a long-term training aimed not only to teach the techniques themselves but to promote the personal and environmental hygienic conditions and to abandon those unhygienic practices which might occur in developing countries.

13. In 1980 the number of manufacturing facilities in developed and developing countries were 72 and 32, respectively.[29/] Recent information however, shows that at least in developing countries the number of active manufacturers is less than 32, in several cases either the manufacturers do not produce vaccines any more or their products are presently not marketed. The above is particularly true for Africa, where hardly half of the existing and locally licensed manufacturers is active. The quality of vaccines as manufactured differs not only from manufacturer to manufacturer but sometimes from batch to batch. National quality control laboratories for vaccines are still the exception rather than the rule, for example, in 1980 there was only one quality control laboratory capable testing DPT vaccine in Africa. Based on the above, one

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29/ International list of availability of vaccines, WHO, BLG/80.1

participant of the Second Consultation suggested that existing manufacturing and quality control facilities should be evaluated and rehabilitated if needed before setting up new units. 30/ It is recommended that the rehabilitated production units should start with blending, filling and packaging of vaccines before they would enter into the actual manufacture. In the light of the above it is worth mentioning and considering that at present only a few manufacturers in developing countries procure quality vaccines in bulk for blending, filling and packaging in spite of the obvious technical and also economic advantages of this practice.

14. Those developing countries which have certified national quality control facility and have already gained experience in blending, filling and packaging bulk vaccines may enter if desired into the actual manufacture of conventional vaccines. The technology to produce classical vaccines is becoming readily available. According to a recent survey 31/ 20 manufacturers are ready for transfer of technology of vaccine included in the "Revised model list of essential drugs" of WHO 32/. Even 6 manufacturers of 4 developing countries expressed their readyness to make their technologies avialable for developing countries. The latter shows that technical co-operation among developing countries (TCDC) can already be envisaged in this early stage of development of this particular sub-sector of pharmaceutical industry in developing countries.

WHO recognised that a number of developing countries were wishing to produce vaccines at the national level and has prepared manuals for production and quality control of several conventional vaccines to provide the necessary technical information. These excellent manuals intend only to provide general information on methods and they should not be regarded as technologicals descriptions, however, their importance cannot be overemphasized.

30/ UNIDO, ID.311, p. 54, 1984

31/ UNIDO/IS.402, p.46-49, 1983

32/ The use of essential drugs, WHO Techn. Rep. Ser., 685, 1983

They can be used as guidelines for developing of production and quality control facilities and also as tools for training of personnel.[33/34/35/36/37/] Apart from WHO publications, van Hemert's monograph is also available for manufacture of vaccines which contains not only technical and financial considerations but also technological details of production. [38/]

Since the technology is available at this stage, that is the stage of introduction of actual manufacture of conventional vaccines, the implementation of these projects required assistance mainly in management and investment. The technical assistance of a solid partner is recommended not only in the whole period of implementation of the project but also during the first years of operation. Even if the different phases of the project could be executed and/or financed by different foreign or local contractors and organizations, the above partner, that can be also the licensor, would be responsible for supervising all of the activities carried out during the implementation.

15. The main elements of the implementation of the projects and the ways and means of the recommended technical and financial assistance is very similar to the assistance provided to implement projects at the previous stage, that is the transfer of technology for blending, filling and packaging of vaccines. The latter are given in paragraph 11. In the following only those aspects are discussed which are considered as particularly important in the transfer of technology for the actual manufacture of conventional vaccines.

15.1. The sources of supply of technology should be identified and the technology should be selected by a foreign expert or a group of experts who may assist the local counterparts. The type of contract for the transfer of technology should also be determined: foreign investment can be involved in the project or it can be executed without this, it can be "packaged" or "unpackaged" transfer of technology.

33/ Manual for the production and control vaccines, Diphteria toxoid, WHO, BLG/UNDP/77.1/Rev.1

34/ ibid, Tetanus toxoid, WHO, BLG/UNDP/77.2/Rev.1

35/ ibid, Pertussis vaccine, WHO, BLG/UNDP/77.3/Rev.1

36/ Procedure for production of cholera vaccine, WHO, CDD/SER.82.1

37/ Manual of details of tests required on final vaccines used in the WHO Expanded Programme on Immunization, WHO,BLG/UNDP/82.1/Rev.1

38/ P. van Hemert, Vaccine production as a unit process, 1971.

15.2. The project can be executed by the licensor (technology supplier). This option is highly recommended by UNIDO since the contract in this case could include the licensor's special obligations and responsibilities during the implementation of the project and also during the first years of operation. This period should be long enough for the licensee (technology recipient) to assimilate the technology and gain experience which is needed to master the difficulties which might occur in the processes of production and quality control.

15.3. Training of personnel at different levels of management, production and quality control could be carried out in the licensor's premises. In this way the personnel could gain direct experience from a well established manufacturer and could assimilate the selected technology during an in-plant training course.

15.4. The successful transfer of technology according to UNIDO can be ensured by long-term continuous technical assistance and support programmes of the licensor. The type of this support programme can differ from country to country depending mainly upon the capabilities and availability of technical infrastructure of this particular sub-sector of the pharmaceutical industry. The scope and duration of such a service should be determined at the time of negotiating the conditions for the transfer of technology. Due to the above special requirements for the transfer of technology to manufacture conventional vaccines, the establishment of a joint-venture could be one of the solutions. The setting up of a joint venture reduces the risk of project failure for the licensee, because it directly involves the licensor, thereby ensuring the interest of the technology supplier in the success thereof. Joint-ventures are however advisable only if there were industrial production technologies. In this case the production facilities could also be developed on subregional or regional basis to achieve economic feasibility.

16. The Second Consultation concluded that the transfer of technology for biologicals could be offered in stages. The third stage would be a step-by-step approach assimilating technologies from filling and packaging to actual manufacture and from the production of classical vaccines to modern ones.For modern vaccines the production facilities could be developed at subregional or regional level to achieve economic feasibility.A further step in the transfer of technology can be the treatment of local blood on a regional basis taking into account the differences of the epidemiological situation in the preparation of specific hyperimmune sera and immunoglobulins. According to the recommendations on the subject, the transfer of technology for modern vaccines should be promoted at national and regional levels where there is adequate technical infrastructure. Promoting the manufacture of certain biologicals other than vaccines at regional level is also recommended if they are either difficult to procure or only used in developing countries .[39]

It was also recommended by the Second Consultation that UNIDO should use the distinction of classical and modern vaccines for practical purposes as classified in the issue paper on "The manufacture of vaccines in developing countries" [40] (see annexure A). In the following all of the improved non-EPI vaccines and modern biotechnological vaccines are referred as modern vaccines.

17. The significance of development of an improved poliovaccine is highlighted by the fact that although the oral (Sabin) poliovaccine has been shown to be effective in the control of poliomyelitis in many countries, in some developing countries, especially in the tropical and semitropical areas the immunity induced by the conventional three doses of oral poliovaccine has been incomplete, and as a consequence the incidence of paralytic poliomyelitis has been unacceptably high in vaccinees .[41] Recently an inactivated (Salk) poliovaccine of improved potency has been developed and also its large-scale manufacture has been established.This vaccine can be used in combination with DPT as a quadruple vaccine, and it is said to be no more expensive to use than the present programme involving the cheaper oral polio vaccine.[42]

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[39] UNIDO: ID/311 p. 10-12 , 1984

[40] UNIDO: ID/WG.393/12/Rev.1, 1983

[41] D.M.Horstmann, Control of poliomyelitis:a continuing paradox , World Health Forum , 4, 264-270,1973

[42] Poliovaccine, Lancet, 1, 1022-1023, 1983

The Public Health importance of an improved rabies vaccine should also be emphasized. Hundreds of thousands doses of neural tissue rabies vaccine are distributed annually in developing countries for rabies post-exposure prophylaxis, although the potency of this type of vaccine is questionable.Further it causes paralytic and other adverse reactions which result in close to 50 % default from treatment and, as a consequence in further reduction of its prophylactic value. By contrast, the protective value and safety of human diploid cell rabies vaccine for pre-exposure and post-exposure use are well established.Although the human diploid cell rabies vaccine is expensive, a more economic regimen using 0.1 ml intradermally has been developed . [43] However, the first step towards a worldwide rabies control could only be achieved by the development of a cheap and effective oral vaccine for immunization of canine population.[44]

18. The public health significance of recently developed vaccines in developing countries can be highlighted by two examples.The purified polysaccharide vaccines such as meningococcal and pneumococcal vaccines are the safest biologicals. Up to now hundreds of million doses of meningococcal vaccine have been administred but no single adverse reaction has ever been reported. These vaccines are highly effective either administered alone or in combination, however only above 2 years of age.The purified polysaccharide vaccines could be included in the immunization programmes in those developing countries, but especially in West African countries where the purulent meningitis caused either by Neisseria meningitidis or Streptococcus pneumoniae is endemic .

Primary liver cancer is perhaps the most common cancer in South-East-Asia and Africa,and it is among the ten most common cancers worldwide killing hundreds of thousands of people annually.There is now strong evidence for an association between the carrier state of hepatitis B virus infection and primary liver cancer which justifies the immunization against hepatitis B to prevent this cancer . Since the incidence of primary liver cancer is about 30 new cases for 100.000 population annually in South-East Asia and Africa, the immunisation against it would have a significant impact on the public health situation. However, the present price of the vaccine is very high,even if it was administered intra-

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[43] Intradermal vaccination, Lancet, 2, 1464-1465 ,1983

[44] G.W.Beran & A.J.Cowley, Toward Worldwide Rabies Control, WHO Chronicle 37, 192-196, 1983

dermally. [45]

19. At present development of new vaccines against many infectious and parasitic diseases prevalent in developing countries is in progress. Before 1975 the world-wide expenditure on research in tropical diseases was estimated at about US$ 30 m annually.Since then the annual expenditure has tripled due to the UNDP/World Bank/WHO Special Programme for Research and Training in Tropical Diseases (TDR). One of the major achievements of this programme is the substantial progress that has been made in fundamental knowledge required to develop an anti-malarial vaccine.

Besides the five most prevalent tropical diseases : malaria, schistosomiasis, filariasis, trypanosomiasis and leprosy, there are other diseases which are common and could be theoretically prevented by vaccination . For instance, the diarrhoeal diseases are one of the major causes of childhood morbidity in developing countries and account for some 5 million deaths annually in chidren below 5 years of age. At least those enteric infections which are due to Vibrio cholerae and Salmonella typhi, new types of vaccines could be developed.

20. The price of the improved and recently developed modern vaccines is generally high and therefore most of the developing countries cannot afford them with their limited financial resources of public-health.If these vaccines are at all available in developing countries they can only be obtained through subsidaries of the large pharmaceutical manufacturers of developed countries, their promotion offices or in some cases from individual retailes. The main reasons for the high pricing are the following:

- the high research and development costs are included in the price,
- the costs of equipment and general facilities are high,
- the large manufacturers are the exclusive suppliers of vaccines, etc.

In addition to the above, the promotion of the hepatitis B vaccine presents a special case because of the limited amount of starting raw material. Since the number of asymptomatic hepatitis virus carriers is limited, the production of vaccines cannot be increased in line with the market demand.The production

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[45] Prevention of hepatocellular carcinoma by immunisation Bull. WHO, 61 731-744, 1983

of this vaccine in many developing countries is out of question since they are even without the proper infrastructure for collection of blood and/or plasma. However, it should be mentioned, that this type of problem connected with the shortage of starting raw materials could be solved by the new techniques recently introduced in some developed countries.

21. Blood products, as vital life-saving biologicals,have utmost importance in the health care programmes of any country.However, some developing countries depend entirely on imports of human plasma factions.The cost of imported material is often prohibitive and well beyond the reach of a large segment of population .The developing countries are not able to meet even a fraction of the demand for blood products,since on one hand the import of these items would mean the depletion of their scarce foreign exchange resources,and on the other hand in most cases they do not possess the technical infrastructure and manufacturing capability for collection and processing of human plasma.

In the light of the above, UNIDO and the Committee for National Co-operation on Pharmaceuticals of the Ministry of Health and Social Affairs, Sweden, together with the WHO and the League of Red Cross Societies organised a Seminar on National Self-Reliance in Blood and Blood Fractions for Developing Countries, in Stockholm, Sweden, 1982 with the view to acquaint representatives of developing countries into the various facets of blood transfusion services and the industrial scale of plasma fractionation.Among the recommendations included in the plan of action of this seminar were that UNIDO should carry out a survey of existing facilities, infrastructure and availability of plasma for fractionation in developing countries, and assist in transfer of technology for establishing/expending/improving plasma fractionation on laboratory/pilot/industrial scale.UNIDO could also provide assistance in training of personnel for production of blood derivatives . [46]

22. The problems relating to the transfer of technology to manufacture modern vaccines and blood products are completely different from the problems arising in the case of conventional vaccines. First of all, the technologies for the manufacture of modern vaccines are not generally available as those of conventional vaccines. The modern vaccines have recently been developed and most of them

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46 Draft Report , UNIDO/ IO, 1983

are patented. The technologies of modern vaccines and blood products are sophisticated.The implementation of the industrial scale technologies require a sound technical infrastructure. The operation of highly specialised manufacturing equipment requires special conditions and in addition careful preventive maintenance. Even if the technologies were available , the implementation of such projects would be very costly and, therefore economically not feasible in those developing countries were neither the technical infrastructure nor the trained personnel are available.According to UNIDO's view, the transfer of technology for manufacturing of modern vaccines is recommended only in those few developing countries which have a certified and economically viable production of conventional vaccines recommended for use in the EPI and a proper infrastructure and trained personnel necessary for the development. It should be noted that joint-venture seems to be the best way in this case. The joint-venture is suggested to be based on an industrial production technology and the production facility is recommended to be developed at subregional or regional level to achieve economic feasibility.

ANNEXURE A

LIST OF THE MOST IMPORTANT CONVENTIONAL AND IMPROVED RECENTLY DEVELOPED VACCINES

CLASSICAL VACCINES

1. BCG vaccine against tuberculosis
2. DPT vaccine against diphtheria, whooping cough and tetanus
3. Tetanus toxoid
4. Diphtheria-Tetanus toxoid
5. Typhoid vaccine
6. Cholera vaccine
7. Oral and inactivated poliomyelitis vaccine
8. Live and inactivated measles vaccine
9. Rabies vaccine prepared in neural tissues
10. Yellow fever vaccine

etc.

IMPROVED OR RECENTLY DEVELOPED VACCINES

1. Rabies vaccine produced in cell cultures
2. Improved poliomyelitis vaccine for parenteral use
3. Hepatitis B vaccine
4. Menongococcal vaccine
5. Pneumococcal polysaccharide vaccine
6. Oral live galactose - epimerase - less typhoid vaccine

etc.

ANNEXURE B

LIST OF TECHNICAL ELEMENTS OF PRODUCTION FACILITIES FOR VACCINES

1. Production:
   a) Building and Services
      Layout and design
      Construction materials
      Clean areas
   b) Equipment and laboratory furnishings
   c) Chemicals and consumables
   d) Staff

2. Quality Control:
   a) Buildings and services
      Layout and design
      Construction materials
      Clean areas
   b) Equipment and laboratory furnishings
   c) Chemicals and consumables
   d) Staff

3. Central Services:
   a) Essential services
      Electricity
      Gas
      Boiler House
      Stand-by emergency generator
      Demineralised and distilled water
      Drainage
      Compressed air and vacuum
   b) Administration
      Offices and record keeping
      Library
      Canteen
      Health care
   c) Glassware washing and sterilization
   d) Media and adjuvant preparation
   e) Filling area
      Filling
      Packaging and labelling
      Visual inspection
   f) Cold storage and despatch
   g) Centra store and supplies
   h) Maintenance workshop
   i) Staff

4. Animal Housing
   a) Building and services
      Layout and design
      Construction materials
      Isolation
      Disinfection and incineration
   b) Feed and bedding
   c) Storage
   d) Staff